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Software Engineering Institute**

Pittsburgh, PA 15213-3890

Acquisition Pilot: Product Line Acquisition and Measurement at NUWC

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Agenda

What are product lines?

Why a pilot in measurement?

How did the pilot apply goal-driven software measurement to product line acquisition?

Results and next steps



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Product Line Framework

A Framework for Software Product Line Practice

Version 4.0

<http://www.sei.cmu.edu/plp/framework.html>

- provides 29 practice areas for software product lines

Software Product Line Acquisition: A Companion to A Framework for Software Product Line Practice

Version 2.0

<http://www.sei.cmu.edu/plp/companion.html>

- places practice areas in acquisition context



What are product lines?

A set of software-intensive systems sharing a common, managed set of features that satisfy the specific needs of a particular market segment or mission and that are developed from a common set of core assets in a prescribed way

| Product Line Definition | For NUWC |
|---|--|
| Set of software intensive systems | Data acquisition, display and control systems for ranges |
| Sharing a common, managed set of features | Features for tracking, archiving, playback, debriefing, analysis, other applications to support range operations |
| (The systems must) <ul style="list-style-type: none">•satisfy the specific needs of a selected market segment or mission•(and be) developed from a common set of core assets | T&E / training range community Rangeware assets including common architecture, pre-built applications, scripts for production builds |
| In a prescribed way | NUWC processes for : <ul style="list-style-type: none">•Java development and maintenance for RangeWare•Production plan for range systems•Configuration management plan |



Applying RangeWare – Savings

| Program Name | Lines of Code Estimated (in 000's) | Actual Lines Developed | Estimated Cost (in 000's) | Actual Cost (in 000's) | Years of development |
|---------------|------------------------------------|------------------------|---------------------------|------------------------|----------------------|
| Subsystem A | 250 | (Est.) 75 | 1562 | | |
| ECSWTR | 245 | 80 | | 1300 | |
| Subsystem B | 150 | (Est.) 45 | 937 | | |
| AHRP | 165 | 25 | | 200 | 99-01 |
| LSVTC | 150 | 20 | | 210 | 01-02 |
| OASYS | 150 | 28 | | 219 | 01-02 |
| SCORE | 150 | 20 | | 115 | 01-02 |
| Eng Prot A | 150 | (Est.) 45 | 937 | | |
| TSMADS | 152 | 22 | | 540 | 99-02 |



Pilot Goals Description

Demonstrate successful product line acquisition practices for measurement within a DoD setting

Goals for the pilot

- Serve as example for future PWS work by demonstrating the overall effectiveness of the Acquisition Companion
- Work hand-in-hand with acquisition organization to obtain and report on adoption from within DoD
- Serve as example for other Navy systems considering product line approaches

Acquisition pilot allows low risk opportunity to apply acquisition practices in such areas as Structuring the Organization, Data Collection, Building a Business Case, Customer Interface Management, and Technology Forecasting



Value and Significance

What is the value to the customer?

- Leverages current improvement plan with SEI processes
- Makes case for strategic funding through measurement and tracking guidance
- Promotes long-term vision for sustained product line development

What is the value to the SEI?

- Leverages development and validation of new methods through work with DoD organization and variety of users
- Matures Acquisition Companion Guidelines through customer work
- Applies cross-functional teams (PLP, SEMA, ASP)

What is the value to the Acquisition community?

- Satisfies requests by others for support in same practice areas (e.g., FBCB2)
- Provides extended case studies of successful technology adoption
- Extends the current NUWC case study in specific practice areas for new product line work at NUWC



Results

Applying Goal Driven Software Measurement to NUWCs product line adoption

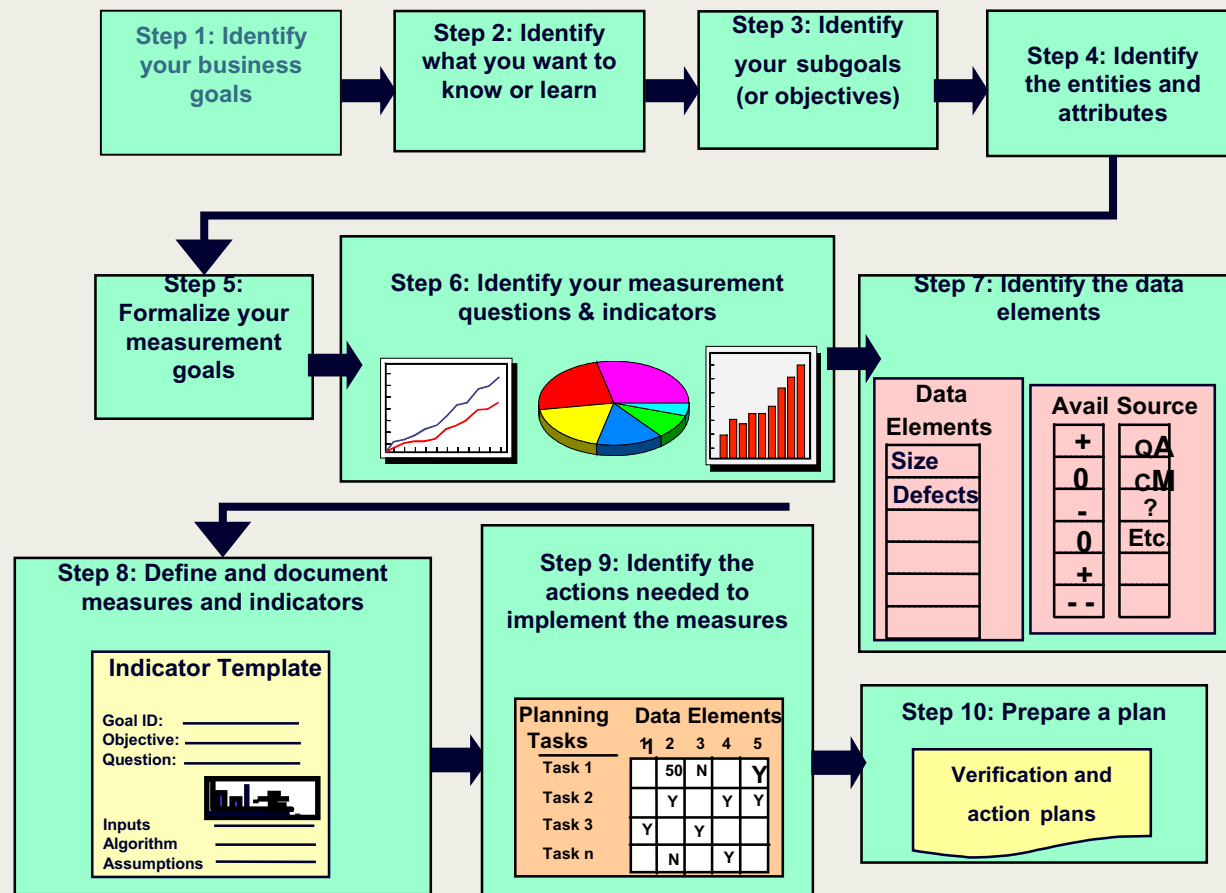
- NUWC has established measurement goals and indicator
- Tracking effort data from Off-board Advanced System Stimulus (OASYS) project
- Three other projects will also be capturing data
- Measurement group with representatives from 4 projects in place

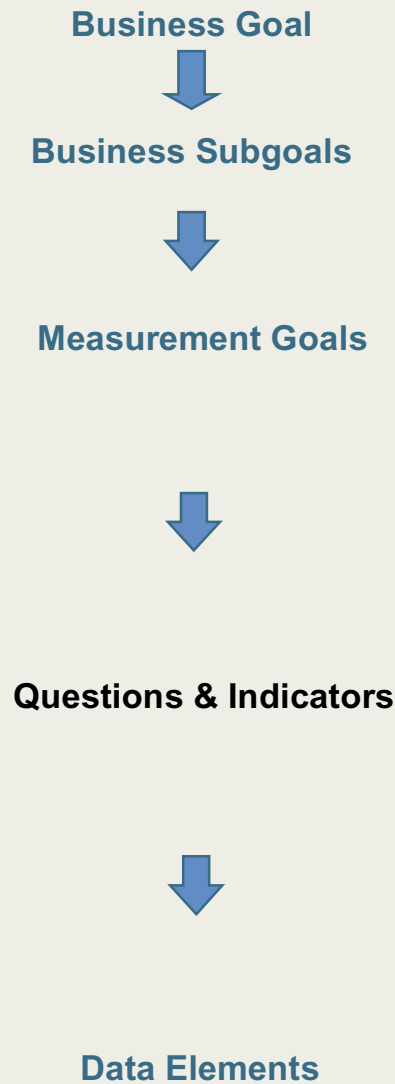
Unexpected and beneficial discoveries

- Goal-Driven Software Measurement to provide basis for product line measurement practices
- Project effort must track WBS, action items, problems reports, other sources of requirements
- New NUWC projects will be applying results of pilot



Goal-Driven Software Measurement



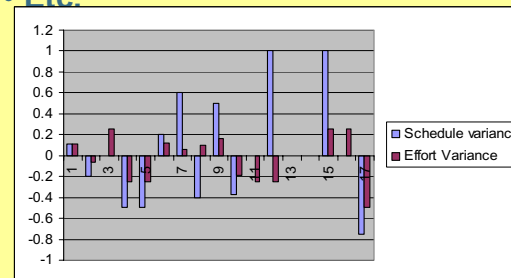


***Become the best value supplier of
high quality range software***

- Improve accuracy of effort estimation process
- Measure effectiveness of Product Line Approach
- Improve ability of products meeting customer requirements

| | |
|-----------------------------|--|
| Object of Interest | Effort estimation process |
| Purpose | Divide SCPs into units that are trackable. Improve ability to make reliable estimates of effort. |
| Perspective | Analyze causes of deviation from effort estimates. Establish correlation between types of software changes to assets and how these affect schedule |
| Environment and Constraints | Use TrackWeb to estimate, track and report effort |

- How reliable are schedule estimates?
- What causes deviations from estimates?
- Etc.



- SCP type
- Effort estimate
- Degree of reuse

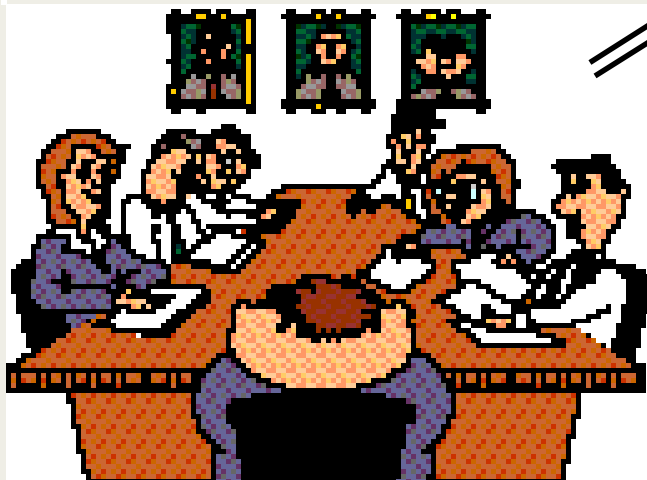


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NUWC Code 71 Business Goal

...Become the best value
supplier of high quality
range software systems

Our principal business
subgoals are ...



**Subgoal #1: Improve
accuracy of effort
estimation process**

**Subgoal #2: Measure
effectiveness of Product
Line Approach**

**Subgoal #3: Improve
ability of products to meet
customer requirements**



Improve accuracy of effort estimation process

For each project:

- Track effort as budgeted compared to effort at completion
- Track budgeted schedule and cost in similar fashion

Use SCP's, AI's, and WBS tasks as the level for tracking this information

Across projects, track variations in use and effect of use of assets (element of Subgoal #2)



Other Indicators

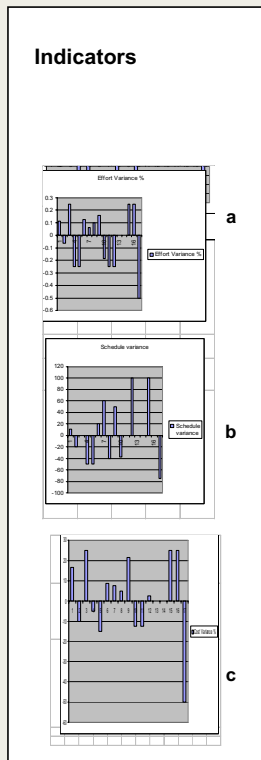
Subgoal #2

- Cost savings from asset use
- Effort savings from asset use

Subgoal #3

- % coverage (degree of reuse)
- Degree of change of assets for meeting customer needs

Necessary Data Elements



| Data Elements | Indicator | | | Avail | Source |
|---|-----------|---|---|-------|------------------------------|
| Required | a | b | c | | |
| 1 Identifier | x | x | x | + | WBS, SCP, AI |
| 2 Description | x | x | x | + | WBS, SCP, AI |
| 3 Requirement | x | x | x | 000 | Requirements doc. |
| 4 Baseline (Effort, Completion) | x | x | | + | WBS (sometimes), AI |
| 5 Revised Baseline | x | x | | 00 | Staff |
| 6 Number of Revision (history) | x | x | | 00 | Staff (not collected now) |
| 7 Rationale for Revision | x | x | | 00 | Staff (not collected now) |
| 8 Actual Effort to Date | x | | | 00 | Timesheets, staff |
| 9 Estimate Effort to Complete | x | | | 00 | Staff |
| 10 Est. Actual Completion Date | | x | | 00 | Staff |
| 11 Revised Completion Date | | x | | 00 | Staff |
| 12 Labor Resource Cost | | | x | 00 | Staff |
| 13 Revised Costs | | | x | 00 | Staff |
| 14 Other Task Cost | | | x | 00 | Staff |
| 15 Actuals (effort,schedule,cost) at complete | x | x | x | 00 | Staff |
| Compute | | | | | |
| Baseline cost (labor and other) | | | x | 00 | Baseline effort * Labor Cost |
| Costs to date | | | x | 00 | Actual Effort * Labor cost |
| % Completed (schedule, effort) | x | x | | 00 | Actual/Baseline *100 |
| % Actual Effort Spent | x | x | | 00 | Actual/To Complete * 100 |
| Estimate (effort, cost) at complete | x | | x | 00 | To Complete – Actual |
| Variance (effort, schedule, cost)) | x | x | x | 00 | To Complete/Baseline * 100 |

| Code | Meaning |
|------|---|
| + | Available |
| 0 | Not explicitly available |
| 00 | - can be derived from other data |
| 000 | - can be obtained via minor effort |
| | - can be obtained via significant effort |
| - | Not available now |
| -- | Impossible to obtain or extremely difficult |

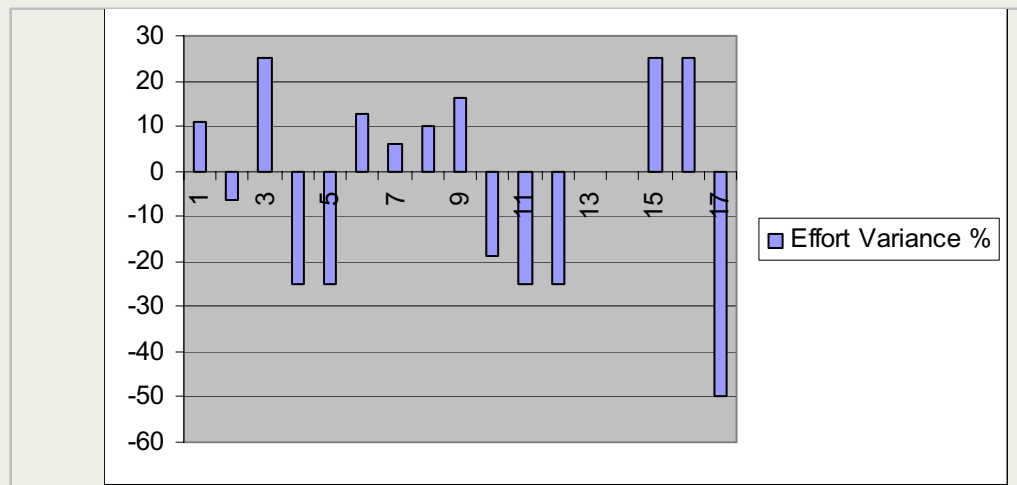
Results: Example Indicator – Effort Variance %

Purpose – measure effort to completion (estimated) against baseline effort

$EV\% = (\text{actual effort} - \text{budgeted effort}) / \text{budgeted effort} * 100$

Perspective - analyze when and why variance occurs

Environment and Constraints – use Trackweb or spreadsheet template to update effort





Next Steps

Examine other subgoals in depth

- Develop questions and indicators
- Identify data items and sources

Use measurement results as basis for analysis across projects in product line

Refine business case



References

Sholom Cohen, Ed Dunn, Albert Soule. “Successful Product Line Development and Sustainment: A DoD Case Study.” CMU/SEI-2002-TN-018. September 2002.

Sholom Cohen, Dave Zubrow, Ed Dunn. “NUWC Case Study: A Measurement Program for Product Lines.” CMU/SEI-2003-TN-039, December 2003. (In final production)



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<http://www.sei.cmu.edu/plp>

Resources

<http://www.sei.cmu.edu/plp>

- Detailed software product line case studies
- Software product line practice framework and acquisition companion
- SEI software product line products and services
- Info about courses and training
- Upcoming events in the software product line community
- Details about SPLC 2004, Boston, Aug-Sep 2004.